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(54) ELECTROPHORETIC DISPLAY PANEL WITH INTERNAL MESH BACKGROUND SCREEN

ELEKTROPHORETISCHE ANZEIGETAFEL MIT INTERNEM NETZARTIGEM HINTERGRUNDSSCHIRM

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(73) Proprietor: **COPYTELE INC.**
Huntington Station New York 11746 (US)

(72) Inventors:
- **DISANTO, Frank, J.**
  North Hills, NY 11030 (US)
- **KRUSOS, Denis, A.**
  Lloyd Harbor, NY 11743 (US)

(74) Representative: **Lucking, David John**
FORRESTER & BOEHMERT
Franz-Joseph-Strasse 38
80801 München (DE)

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- **PATENT ABSTRACTS OF JAPAN vol. 14, no. 337 (P-1079) (4280) 20 July 1990 & JP-A-02 114 239 (KINSEKI) 26 April 1990**
- **PATENT ABSTRACTS OF JAPAN vol. 13, no. 389 (P-925) (3737) 29 August 1989 & JP-A-01 137 240 (KINSEKI) 30 May 1989**
- **PATENT ABSTRACTS OF JAPAN vol. 14, no. 337 (P-1079) (4280) 20 July 1990 & JP-A-02 114 239**
- **PATENT ABSTRACTS OF JAPAN vol. 13, no. 389 (P-925) (3737) 29 August 1989 & JP-A-01 137 240**

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Description

Technical Field

The present invention relates to an electrophoretic display panel apparatus and, more particularly, to triode and tetrode-type electrophoretic display panels having an internal mesh screen which enhances display operation.

Background Art

Electrophoretic displays (EPIDS) are now well known. A variety of display types and features are taught in several patents issued in the names of the inventors herein, Frank J. Disanto and Denis A. Krusos and assigned to the assignee herein, Copytele, Inc. of Huntington Station, New York. For example, U.S. Patent Nos. 4,655,897 and 4,732,830, each entitled ELECTROPHORETIC DISPLAY PANELS AND ASSOCIATED METHODS describe the basic operation and construction of an electrophoretic display. U.S. Patent No. 4,742,345, entitled ELECTROPHORETIC DISPLAY PANELS AND METHODS THEREFOR, describes a display having improved alignment and contrast. Many other patents regarding such displays are also assigned to Copytele, Inc. Two pending patent applications which may have some relevance to the present invention are published under No. WO-A-9215982 entitled ELECTROPHORETIC DISPLAY PANEL WITH PLURAL ELECTRICALLY INDEPENDENT ANODE ELEMENTS and No. EP-A-396247 entitled DUAL ANODE FLAT PANEL ELECTROPHORETIC DISPLAY APPARATUS, each of which shall be described below.

The display panels shown in the above-mentioned patents operate upon the same basic principle, viz., if a suspension of electrically charged pigment particles in a dielectric fluid is subjected to an applied electrostatic field, the pigment particles will migrate through the fluid in response to the electrostatic field. Given a substantially homogeneous suspension of particles cathode and grid lines are employed, there are numerous discrete intersection points which can be controlled by varying the voltage on the cathode and grid lines to cause localised visible regions of pigment concentration and rarefaction. Essentially then, the operating voltages on both cathode and grid must be able to assume at least two states corresponding to a logical one and a logical zero. Logical one for the cathode may either correspond to attraction or repulsion of pigment. Typically, the cathode and grid voltages are selected such that only when both are a logical one at a particular intersection point, will a sufficient electrostatic field be present at the intersection relative to the anode to cause the writing of a visual bit of information on the display through migration of pigment particles. The bit may be erased, e.g. upon a reversal of polarity and a logical zero-zero state occurring at the intersection co-ordinated with an erase voltage gradient between anode and cathode. In this manner, digitized data can be displayed on the electrophoretic display.

An alternative EPID construction is disclosed in WO-A-9215982, referred to above, which relates to an electrophoretic display in which the previously described grid of electrically independently controllable elements or lines is replaced with a monolithic or electrically continuous grid. Further, the monolithic anode is replaced with a plurality of discrete, electrically independent elements. In displays constructed in accordance with the teachings of the aforesaid application, pixel writing and erasure is accomplished by impressing a voltage gradient between a selected anode element and a selected intersecting cathode line such that at their point of intersection, the gradient is sufficient to overcome a constant barrier voltage on the monolithic grid element causing migration of pigment particles past the grid.

A further alternative EPID construction is described in EP-A-396247, referred to above, which relates to an electrophoretic display in which the cathode/grid matrix as is found is triode-type displays is overlayed by a plurality of independent separately addressable "local" anode lines, thereby constituting a tetrode-type display. The local anode lines are deposited upon and align with the grid lines and are insulated therefrom by interstitial lines of photoresist. The local anode lines are in addition to a "remote" anode, which is a layer deposited upon the anode faceplate as in triode displays. The dual anode structure aforesaid provides enhanced operation by eliminating unwanted variations in display brightness between frames, increasing the speed of the display and decreasing the anode voltage required during Write and Hold cycles, all as explained in EP-A-396247.

To be useful as a display, an electrophoretic display must be able to assume a blank or erased state; must be able to display character data written during a Write operation; and must be able to continually maintain or hold the written characters (and blank characters) in a Hold mode until they are erased or overwritten. These three modes of operation, i.e. Erase, Write and Hold are well documented in existing patents issued to the inventors herein and such description shall not be repeated at length herein.

One aspect of visual displays of all kinds which is a constant object of improvement is the clarity or resolution of the display. Resolution is at least partially dependent upon the size and number of the pixels which comprise the image. Resolution is also a function of the number of lines per inch associated with the display as well as the number of pixels per line. As is known in monochromatic displays, data can be displayed using two colors, i.e. a foreground color (A) and a background color (B) which may be interchangeable or reversible. That is, in a first mode of operation, color (A) is selected as foreground and color (B) serves as the background color. In a second mode of operation, color (B) is used

to represent foreground data and color (A) to represent the background. A frequently used color combination in an electrophoretic display is a yellow foreground against black/dark blue background, i.e., yellow pigment particles are suspended in a black/dark blue solution. In many instances, the solution is colored by a black/dark blue dye dissolved in a solvent. In order to achieve a sharp color contrast between the light colored pigment particles and the dark solution, a high concentration of dye is normally required. A high concentration is required due to the transparency of EPID displays (absent the dye) and to the thickness of the display. Since the dark solution fills the EPID display and surrounds the light coloured pigment particles; high dye concentrations diminish display brightness and contrast. That is, even when the pigment particles are in the display position, not all dye is excluded from in between the particles or from in between the particle agglomeration and the glass faceplate through which it is viewed.

A further form of EPID described in a patent issued in the names of the inventors is found in US Patent No. 5,041,824, entitled SEMITRANSPARENT ELECTROPHORETIC INFORMATION DISPLAYS (EPID) EMPLOYING MESH LIKE ELECTRODES. The electrophoretic display includes a plurality of intersecting grid and cathode lines which are spaced from each other by an insulating material, and a planar anode deposited on a glass plate. Interposed between the cathode and grid and the anode is a mesh electrode which is relatively the same size as the anode. Control voltages are applied to the mesh and anode to control particle propagation. The conventional anode may be entirely replaced with a mesh-like structure to provide an (EPID) which can be optimumly illuminated by back lighting.

Early electrophoretic displays, such as that described in US Patent No. 3,668,106, only included anode and cathode electrodes, with no intermediate electrode(s).

An alternative form of electrophoretic display device is disclosed in Japanese Application No. 62-296379. It comprises intermediate electrodes for providing intermediate graduations.

It is therefore an object of the present invention to provide an electrophoretic display with increased brightness and contrast by substantially reducing the above-described unwanted dye effect.

Disclosure of the Invention

The problems and disadvantages associated with the image resolution and brightness of conventional electrophoretic displays using contrast dye in the electrophoretic fluid are overcome by the present invention which includes an electrophoretic display having a fluid-tight envelope with a portion thereof which is at least partially transparent. An electrophoretic fluid is contained within the envelope and has pigment particles suspended therein. The display has electronics for selectively positioning the particles within the envlcope such that they form images which are visible to a viewer when viewed through the transparent portion. A screen or mesh is disposed within the envlope and divides an interior space in the envelope containing the fluid into a front portion proximate the transparent portion of the envelope and a back portion distal to the transparent portion. The mesh is at least partially opaque when viewed through the transparent portion of the envelope and obscures the particles from being viewed through the transparent portion when the particles are in the back portion. The screen or mesh allows the particles to pass through the pores under the control of the electronics such that the particles can be viewed or obscured depending upon their position with respect to the screen.

Brief Description of the Drawings

FIG. 1 is an exploded perspective view of an electrophoretic display in accordance with an exemplary embodiment of the present invention.

FIG. 2 is a cross-sectional view of the electrophoretic display shown in FIG. 1 in the unexploded state, taken along section line II-II and looking in the direction of the arrows.

FIG. 3 is an exploded perspective view of an electrophoretic display in accordance with a second exemplary embodiment of the present invention.

FIG. 4 is a cross-sectional view of the electrophoretic display shown in FIG. 3 in the unexploded state, taken along section line IV-IV and looking in the direction of the arrows.

FIG. 5 is a schematic diagram showing the connection of the devices depicted in FIGS. 1 through 4 to a power supply as controlled by a controller.

Best Mode for Carrying Out The Invention

FIG. 1 shows an electrophoretic display 10 in accordance with the present invention. The display 10 has an anode faceplate 12 and a cathode faceplate 14 which are sealably affixed on either side of interstitial spacers 16a and 16b to form a fluid tight envelope for containing dielectric/pigment particle suspension or electrophoretic fluid (not shown). The faceplates 12 and 14 are typically flat glass plates upon which are deposited conductor elements. The techniques, materials and dimensions used to form the conductor elements upon the faceplates and the methods for making EPIDS, in general, are shown in U.S. Patent Nos. 4,655,897, 4,732,830 and 4,742,345 which patents are incorporated herein by reference.

As depicted in FIG. 1, a plurality of independent, electrically conductive cathode elements or lines 18 (horizontal rows) are deposited upon the cathode faceplate 14 using conventional deposition and etching techniques. It is preferred that the cathode members 18 be composed of Indium Tin Oxide (ITO) as set forth in U.

S. Patent No. 4,742,345. A plurality of independent grid conductor elements or lines 20 are superposed in the vertical over the cathode lines 18 and are insulated therefrom by an interstitial photoresist layer 22 (see FIG. 2). The terms horizontal and vertical are used in regard to the orientation shown in Figure 1, but can be interchanged. The grid lines 20 may be formed by coating the photoresist layer 22 with a metal, such as nickel, using sputtering techniques or the like, and then selectively masking and etching to yield the intersecting but insulated configuration shown in FIGS. 1 and 2. Each cathode and grid line 18, 20 terminates at one end in a contact pad 24 or is otherwise adapted to permit connection to display driver circuitry (not shown). An anode 26 is formed on an interior surface of the anode faceplate 12 by plating with a thin layer of conductor material, such as, chrome. A novel mesh element or screen 28 is sandwiched between spacers 16a and 16b to provide at least a partial barrier to the passage of light through the EPID 10. The mesh 28 has a plurality of pores 29 through which pigment particles may pass so as not to obstruct the normal operation of the EPID. Coincidental to the light barrier function, the mesh itself is an optically significant element, i.e., it is readily visible to the naked eye. In a preferred form, the mesh is constructed in a manner so that it is maximally visible, but the pores in the mesh are not visible, i.e., it is preferred that the mesh appear as a flat planar object. This is achieved by making the mesh with the minimum pore size which does not critically impede pigment movement. A screen having suitable characteristics is commercially available from the Buckee Mears Co., viz., a perforated stainless steel mesh having an approximate thickness and pore size of 10 to 12 mils. The mesh has an open area ratio, i.e., the ratio of the sum of pore area to the total surface area on one surface of the screen, of approximately 40% to 50%. The mesh is blackened by an anodizing process. The significance of the mesh screen 28 is that it provides a solid visual background for the display of pixels and it permits a reduction of dye concentration to effect a desired background intensity. For example, if the mesh were used in an EPID utilizing black/dark blue solution and yellow pigment particles, it could be colored black on at least one side so that the blackened side would function as a black background to enhance the background intensity attributable to the solution. It has been observed that the above-described mesh screen provides such an effective background that no dye is required. Even if a less effective mesh were used, the objective of increased contrast would be realized because dye concentration along with unwanted dye effects could be decreased. The screen 28 also functions to prevent inadvertent backlighting due to the overall translucence of the EPID 10. Since the screen allows for the reduction or elimination of dye, the pigment particles are more readily visible when in the display position and display brightness and contrast are increased. It should be observed that the screen 28 is positioned in the EPID 10 such that when the pigment is in the display position, it is on one side of the screen 28 and when it is in the fully written position it is on the other side of the screen 28, obscured from view by the screen 28 and/or dye in the solution.

It is preferable to fabricate the screen 28 from a conductive material enabling the screen to carry an electric charge for the purpose of aiding in controlling the movement of the pigment particles. By utilizing the screen 28 as an electrode, the effect of the screen 28 as a physical barrier is compensated for and permits it to act solely as a visual barrier.

To form an EPID 10 like that shown in FIG. 1, the parts may assembled in a stack and placed in an oven for baking. The spacers 16a and 16b, in that case, would be coated on surfaces which contact adjacent elements with a material which would become plastic at baking temperatures, such as, epoxy. Upon baking, the meltable material flows and the elements form a laminate upon cooling. Of course, other methods exist within the scope of the normally skilled artisan for assembling the elements of the EPID 10 shown, such as, e.g., gluing. The lamination of the EPID elements forms an envelope for containing the dielectric fluid/pigment particle suspension.

The cathode and grid lines 18 and 20 of the electrophoretic display 10 can assume a variety of voltages during operation for controlling the display operations of erase, hold and write. A typical panel has a large number of intersections, e.g., 2,200 X 1,700 or a total of 3,740,000 separately addressable intersection points. For ease of illustration, however, only a few cathode lines 18 and grid lines 20 are depicted. Similarly, the shape and proportions of the elements depicted are for purposes of illustration only. The dimensions of the respective elements have also been greatly enlarged for illustration and are not necessarily in proportion to an actual operational device. More illustrations of electrophoretic displays, their components and electrical circuitry can be seen by referring to U.S. Patents Nos. 4,742,345 and 4,772,820, each being awarded to the inventors herein and which are incorporated by reference herein.

Certain details have been omitted from the device depicted, but are taught in prior patents. For example it has been determined that a SiO_2 coating on certain of the conductor elements provides beneficial results. See Application No. 07/675,733. Similarly, conductor elements having a tined configuration provide enhanced resolution, see U.S. Patent No. 4,742,345.

FIG. 2 shows the electrophoretic display of FIG. 1 assembled and in cross-section. The anode 26 in the embodiment shown, is a plate-like area of conductor material having a length and width essentially matching that of the cathode/grid matrix, i.e., coextensive with the matrix, as is taught in the above referenced patents and applications of the present Applicant. The cathode elements 18, grid elements 20 and grid insulator strips 22

as are also like those shown in the foregoing patents, etc. Since all conductor elements are quite thin, they extend beneath the interstitial spacers 16a and 16b without special provision and at least one end thereof provide a terminal exterior to the envelope for connecting display driver circuitry (not shown). For the purposes of illustration, epoxy bonding material 30 is depicted providing the laminating bond between spacers 16 and the faceplates 12 and 14 and for laminating the mesh screen 28 between the spacers 16a and b.

As stated above, the mesh screen 28 is preferably formed from a conductive material and is electrically biased to overcome any physical barrier it presents to particle migration. Exemplary voltages applied to the various elements in the EPID to perform certain basic functions are set forth below.

For the following operations, typical voltages would be:

+V1 = +200 (PULSED TO +400 DURING WRITING OF IMAGE)
-V1 = -300
+V2 = +140
-V2 = -200
V_G HIGH = 0 (PULSED TO +3.0 DURING WRITING OF IMAGE)
V_G LOW = -10
VAC = 100 V RMS
V_K HIGH = +15 (PULSED TO +18 DURING WRITING OF IMAGE)
V_K LOW = 0

FULL WRITE:

V ANODE = +V1
V MESH = VAC
V GRID = V_GHIGH
V CATH = V_K LOW

ERASE:

V ANODE = -V1
V MESH = -V2
V GRID = V_G HIGH
V CATH = V_K LOW

HOLD:

V ANODE = +V1
V MESH = +V2
V GRID = V_G LOW
V CATH = V_K HIGH

PREPARE FOR SELECTIVE IMAGE WRITING:

Set V MESH = VAC for 2 seconds, then return V MESH = +V2

TO WRITE AN IMAGE:

V ANODE = +V1
V MESH = pulsed from +V2 to +V1 (+400)

The image is then written in the usual manner by loading data into the grid elements and sequentially making each cathode low.

TO HOLD WRITTEN IMAGE

V ANODE = +V1
V MESH = VAC
V GRID = V_G LOW
V CATH = V_K HIGH

After 2 seconds return V MESH = +V2

TO REMOVE POWER FROM THE DISPLAY WITHOUT DISTURBING THE IMAGE:

V ANODE = +V1
V MESH = -V1
V GRID = V_G HIGH
V CATH = V_K LOW

Power is then removed from the anode, grid, cathode and mesh in that order. The display is thus completely removed from power, but the image displayed remains undisturbed.

By writing with AC on the mesh and a positive voltage on the anode, all pigment has been removed from the front surface and only the black mesh is visible. Thus, even in a suspension which is completely devoid of dye, the black background is very black and the pigment appears much brighter, improving contrast and permitting the panel to be operated at a lower illumination.

FIGS 3 and 4 illustrate the incorporation of the above-described mesh screen 28 into a tetrode-type display. As can be readily determined by comparing FIGS 1 and 2 to FIGS 3 and 4, many of the basic elements of the display 10 are similar or the same in both triode and tetrode-type displays. The same reference numerals identifying similar elements shared by both embodiments are employed to point out this similarity. The embodiment shown in FIGS 3 and 4 differs from that previously described with respect to the addition of a plurality of local anode elements 32 which are deposited upon corresponding photoresist insulator strips 34 (see FIG. 4) formed upon the grid elements 20. The methods for forming the local anode elements 32 are set forth at length in Application No. 07/345,825. In brief, a layer of photoresist is applied over the grid elements 20, which are formed from a first metal, such as, chrome. A layer of a second metal, e.g., nickel or aluminum, is applied over the photoresist layer. Yet another layer of photoresist is applied over the second metal layer, and

is then masked, exposed and developed in the same form as the grid elements. The second metal layer is then etched with a suitable solution. The photoresist between the first and second metal layers is then plasma etched. A layer of SiO_2 is then deposited over the resulting structure.

As in the triode-type display, the screen 28 is preferably constructed from a conductor material and is electrically biased to assist in pigment particle position control. The following are exemplary voltages applied to the aforesaid elements to effect certain basic display operations.

For the following operations, typical voltages would be:

+V1 = +200 (PULSED TO +400 DURING WRITING OF IMAGE)
-V1 = -300
+V2 = +140
-V2 = -200
V_G HIGH = 0 (PULSED TO +3.0 DURING WRITING OF IMAGE)
V_G LOW = -10
V_K HIGH = +15 (PULSED TO +18 DURING WRITING OF IMAGE)
V_K LOW = 0
VLAH = +20 (PULSED TO +32 DURING WRITING OF IMAGE)
V3 = +20 (PULSED TO +32 DURING WRITING OF IMAGE)
VAC = 100 V RMS
(ANODE = REMOTE ANODE; L.A. = LOCAL ANODE)

FULL WRITE:

V ANODE = +V1
V MESH = VAC
V L.A. = 0
V GRID = V_G HIGH
V CATH = V_K LOW

ERASE:

V ANODE = -V1
V MESH = +V3
V L.A. = 0
V GRID = V_G HIGH
V CATH = V_K LOW

HOLD:

V ANODE = +V1
V MESH = +V2
V L.A. = 0
V GRID = V_G LOW
V CATH = V_K HIGH

PREPARE FOR SELECTIVE IMAGE WRITING:

Connect MESH to VAC for 2 seconds
Return MESH to +V2
V ANODE = VLAH Connect REMOTE ANODE and MESH to LOCAL ANODE
V MESH = VLAH
V L.A. = VLAH
V GRID = V_G LOW
V CATH = V_K HIGH

TO WRITE IMAGE:

The image is written in the usual manner by loading data into the grid elements and sequentially making each cathode low.

HOLD IMAGE:

After writing the image, set the voltages as follows:

V ANODE = VLAH
V MESH = VLAH
V L.A. = VLAH
V GRID = V_G LOW
V CATH = V_K HIGH

HOLD IMAGE WITHOUT POWER:

To completely remove power from the panel without losing the image, proceed as follows:

V ANODE = +V1
V MESH = +V2
V L.A. = 0
V GRID = V_G LOW
V CATH = V_K HIGH
V MESH = VAC FOR 2 SECONDS
V MESH = RETURN TO -V1
REMOVE VOLTAGE FROM ANODE, GRID, CATHODE AND MESH

HOLD IMAGE WITHOUT POWER ALTERNATE:

An alternate method for removing power from the panel without losing the image is:

V ANODE = VLAH
V MESH = -V2
V L.A. = VLAH
V GRID = V_G LOW
V CATH = V_K HIGH

Remove voltage from ANODE, LOCAL ANODE, GRID, CATHODE, and finally MESH.

By connecting the mesh to AC in the HOLD state and pulsing the positive anode, all excess goes through the mesh holes to the anode and after writing to the local

anode, in the areas where pigment has been removed from the front surface, only the black mesh screen is visible. Thus, the suspension does not contain dye and the pigment brightness is greatly enhanced. Since the black is very dark and the pigment is brighter, the contrast is better and the panel may be viewed at lower illumination.

FIG. 5 illustrates in schematic form how the various components of the electrophoretic displays described above in reference to FIGS. 1 through 4 might be electrically connected to a suitable power supply 36 under the control of a digital controller 38 in order to assume the correct voltage states during the operations described.

It should be understood that the embodiments described herein are merely exemplary and that a person skilled in the art may make many variations and modifications without departing from the scope of the invention as defined in the appended claims.

Claims

1. An electrophoretic display (10) including:

   (a) a fluid-tight envelope (12,14) having a portion thereof which is at least partially transparent;
   (b) an electrophoretic fluid contained within said envelope (12,14) having pigment particles suspended therein;
   (c) means for selectively positioning (18,20,26) said particles within said envelope (12,14) such that said particles form images which are visible to a viewer when viewed through said transparent portion, the means for selectively positioning including a cathode (18), a grid (20) and an anode (26); and,
   (d) a mesh (28) composed of an electrically conductive material disposed within said envelope (12,14) and dividing an interior space in said envelope (12,14) containing said fluid into a front portion proximate said transparent portion of said envelope (12,14) and a back portion distal to said transparent portion, said mesh (28) being selectively electrically chargeable to induce movement of said particles within said fluid in co-operation with said positioning means (18,20,26),

   characterised in that said mesh (28) is at least partially opaque when viewed through said transparent portion of said envelope (12,14) and obscures said particles from being viewed through said transparent portion when said particles are in said back portion, said mesh (28) allowing said particles to pass through under the control of said positioning means (18,20,26) such that said particles can be viewed or obscured depending upon the position of said particles with respect of said mesh (28).

2. A display (10) according to Claim 1, characterised in that said pigment particles have a colour which is differentiable from that of said fluid and from that of said mesh (28).

3. A display (10) according to Claim 2, characterised in that the open area ratio for said mesh (28) is approximately from 40% to 50%.

4. A display (10) according to Claim 3, characterised in that said mesh (28) is black in colour.

5. A display (10) according to Claim 4, characterised in that said fluid is at least partially transparent.

6. A display (10) according to Claim 5, characterised in that said mesh (28) is anodized.

7. A display (10) according to Claim 6, characterised in that said pigment particles are yellow.

8. A display (10) according to Claim 7, characterised in that said display (10) has a first operating mode in which said pigment particles represent the foreground component of a displayed monochrome image and said mesh (28) represents the background component of said displayed image and a second operating mode in which said pigment particles represent the background component of said displayed monochrome image and said mesh (28) represents the foreground component of said displayed image.

9. A display (10) according to Claim 8, characterised in that said display (10) is a triode-type display having the anode (26) disposed proximate said transparent portion, the cathode (18) and the grid (20) disposed in said back portion.

10. A display (10) according to Claim 9, characterised in that said transparent portion of said envelope (12,14) includes a portion through which said back portion can be viewed.

11. A display (10) according to Claim 8, characterised in that said display (10) is a tetrode-type display having a local anode (32) overlying the grid (20) said positioning means further including said local anode (32).

12. A display according to Claim 11, characterised in that said transparent portion of said envelope (12,14) includes a portion through which said back portion can be viewed.

13. A display according to Claim 1, characterised in that

said cathode (18) includes a plurality of elongated substantially parallel horizontal conductor members disposed within a first plane and at least partially contained within said envelope, said grid (20) includes a plurality of elongated substantially parallel vertical conductor members and at least partially contained within said envelope(12,14) electrically insulated from said horizontal members and disposed within a second plane, said first and said second planes being substantially parallel and in proximity to each other, said plurality of horizontal members and said plurality of vertical members forming a matrix with a plurality of intersections when viewed along a line perpendicular to said first and said second planes, and a substantially planar conductor member (26) disposed within a third plane proximate and substantially parallel to said second plane and at least partially contained within said envelope (12,14), said mesh (28) being disposed between said vertical members (20)and said planar member (26).

14. A display (10) according to Claim 13, characterised in that said mesh (28) is substantially coextensive with said horizontal members (18) and with said vertical members (20) and has a colour contrasting with that of said pigment particles.

15. A display (10) according to Claim 14, characterised in that said mesh (28) is electrically insulated from said vertical members (20) and planar conductor member (26).

16. A display (10) according to Claim 13, characterised in that said fluid is substantially transparent.

17. A display (10) according to Claim 16, characterised in that said envelope (12,14) includes a first flat faceplate (12), a central portion of which is said transparent portion of said envelope (12,14), said first faceplate (12) being a substrate for supporting said planar member (26).

18. A display (10) according to Claim 17, characterised in that said envelope includes a second substantially flat faceplate (14) and at least one spacer (16a, 16b) interposed between and sealably attached to said first and second faceplates (12,14) to form said envelope, said plurality of horizontal conductor members (18) being positioned proximate said second faceplate (14).

19. A display (10) according to Claim 18, characterised in that said at least one spacer includes two spacers (16a,16b), a first sealably affixed to said first faceplate (12) and a second sealably affixed to said second faceplate (14), said first and second spacers (16a,16b) sealably affixing to each other distal to said first and second faceplates (12,14) and sandwiching said mesh (28) therebetween.

20. A display (10) according to Claim 19, characterised in that said second faceplate (14) is a substrate for supporting said plurality of horizontal conductor members (18).

21. A display (10) according to Claim 20, characterised in that said second faceplate (14) is at least partially transparent and said electrophoretic fluid is visible therethrough, said display (10) being in its entirety at least partially translucent in a direction perpendicular to said first and second faceplates (12,14).

22. A display (10) according to Claim 21, characterised in that said mesh (28) reduces the translucence of said display (10).

23. A display (10) according to Claim 22, characterised in that said pigment particles are yellow.

24. A display (10) according to Claim 16, characterised in that a dye of approximately the same colour as said mesh (28) is added to said fluid.

25. A display (10) according to Claim 21, characterised in that said display (10) is a triode-type display, said plurality of horizontal members (18) being the cathode, said plurality of vertical members (20) being the grid and said planar member (26) being the anode.

26. A display (10) according to Claim 21, characterised in that said display (10) is a tetrode-type display, said plurality of horizontal members (18) being the cathode, said plurality of vertical members (20) being the grid and said planar member (26) being a remote anode and further including a plurality of local anode elements (32) deposited upon said grid elements (20) in alignment therewith and insulated therefrom by interstitial insulator strips (22).

27. A display (10) according to Claim 1, characterised in that said positioning means includes said cathode (18) consisting of a plurality of parallel conductor members arranged in a given direction, a grid (20) insulated from said cathode (18) and consisting of a plurality of parallel conductor members each perpendicular to said cathode conductor members to form an X-Y addressing matrix, and a conventional anode (26) separated from said X-Y addressing matrix.

28. A device (10) according to Claim 27, characterised in that said mesh (28) is perforated by a plurality of perforations (29) through which said particles pass, said mesh (28) when interposed between a viewer

and said pigment particles at least partially obscuring said pigment particles from view.

29. A device (10) according to Claim 27, characterised in that said display (10) further includes a local anode (32) comprising a plurality of parallel conductor members each associated with and insulated from a respective grid (20) conductor member with said local anode (32) operative to control the path of said pigment particles to and from said X-Y addressing matrix and through said mesh (28) and to allow excess pigment to remain at said conventional anode (26).

30. A method of operating an electrophoretic display (10) as defined in Claim 27 which includes the steps of:

electrically connecting said cathode (18), said grid (20), said mesh (28) and said conventional anode (26) to a source of electrical potential energy, said source providing a range of independent and selectively variable voltages to each of said cathode (18), said grid (20), said mesh (28) and said conventional anode (26) under the control of control means for controlling the voltage level supplied by said source to each of said cathode (18), said grid (20), said mesh (28) and said conventional anode (26), and

controlling said source of electrical potential energy with said control means such that voltage levels are applied to said cathode (18), said grid (20), said mesh (28) and said conventional anode (26) for performing display operations.

31. The method of Claim 30, wherein said display (10) operation includes placing said display (10) in a POWER-OFF-IMAGE-HOLD mode wherein a written said image is held on said display (10) after the removal of power from said display (10) by disconnecting said source of electrical potential from said conventional anode (26), said cathode (18), said grid (20) and said mesh (28), in that order.

32. The method of Claim 31, further comprising the step of electrically connecting said controlled source of electrical potential energy to a local anode (32), voltage levels supplied to said local anode (32) being included in said step of controlling for performing display operations.

33. The method of Claim 32 wherein said display operation includes placing said display (10) in a POWER-OFF-IMAGE-HOLD mode wherein a written said image is held on said display (10) after the removal, of power from said display (10) by disconnecting said source of electrical potential from said conventional anode (26), said local anode (32), said cathode (18), said grid (20) and said mesh (28), in that order.

34. The method of Claim 33, wherein said display operation includes placing said display (10) in a POWER-OFF-IMAGE-HOLD mode wherein a written said image is held on said display (10) after the removal of power from said display (10), said POWER-OFF-IMAGE-HOLD mode being achieved by said source providing under the control of said control means approximate levels of +200 v to said conventional anode (26), -300 v to said mesh (28), +200 v to said local anode (32), -10 v to said grid (20) and +1.5 to 3.0 v to said cathode (28), then disconnecting said source of electrical potential from said conventional anode (26), said local anode (32), said grid (20), said cathode (20) and said mesh (28), in that order.

Patentansprüche

1. Elektrophoretische Anzeige (10) mit folgenden:

(a) einem flüssigkeitsdichten Gehäuse (12, 14), von dem ein Teil mindestens teilweise durchsichtig ist;
(b) einer im besagten Gehäuse (12, 14) enthaltenen elektrophoretischen Flüssigkeit mit darin suspendierten Pigmentteilchen;
(c) Mitteln zur gezielten Positionierung (18, 20, 26) der besagten Teilchen in besagtem Gehäuse (12, 14), so daß die besagten Teilchen Bilder bilden, die bei Betrachtung durch den besagten durchsichtigen Teil für einen Betrachter sichtbar sind, wobei die Mittel zum gezielten Positionieren eine Kathode (18), ein Gitter (20) und eine Anode (26) umfassen; und
(d) einem aus einem elektrisch leitfähigen Material zusammengesetzten Maschengitter (28), das im besagten, die besagte Flüssigkeit enthaltenden Gehäuse (12, 14) angeordnet ist und einen Innenraum im besagten die besagte Flussigkeit enthaltenden Gehäuse (12, 14) in einen Vorderteil in der Nähe des besagten durchsichtigen Teils des besagten Gehäuses (12, 14) und einen vom besagten durchsichtigen Teil entfernten Hinterteil einteilt, wobei das besagte Maschengitter (28) gezielt elektrisch geladen werden kann, um Bewegung der besagten Teilchen in der besagten Flüssigkeit in Zusammenwirkung mit den besagten Positionierungsmitteln (18, 20, 26) zu bewirken,

dadurch gekennzeichnet, daß das besagte Maschengitter (28) mindestens teilweise lichtundurchlässig ist, wenn es durch den besagten durchsich-

tigen Teil des besagten Gehäuses (12, 14) betrachtet wird, und es die besagten Teilchen gegen Betrachtung durch den besagten durchsichtigen Teil verdeckt, wenn sich die besagten Teilchen im besagten Hinterteil befinden, wobei das besagte Maschengitter (28) die besagten Teilchen unter Steuerung der besagten Positionierungsmittel (18, 20, 26) durchläßt, so daß die besagten Teilchen je nach der Lage der besagten Teilchen in bezug auf das besagte Maschengitter (28) betrachtet werden oder verdeckt sein können.

2. Anzeige (10) nach Anspruch 1, dadurch gekennzeichnet, daß die besagten Pigmentteilchen eine Farbe aufweisen, die sich von der der besagten Flüssigkeit und von der des besagten Maschengitters (28) unterscheiden läßt.

3. Anzeige (10) nach Anspruch 2, dadurch gekennzeichnet, daß das Verhältnis des offenen Bereichs für das besagte Maschengitter (28) annähernd zwischen 40% und 50% beträgt.

4. Anzeige (10) nach Anspruch 3, dadurch gekennzeichnet, daß das besagte Maschengitter (28) schwarz gefärbt ist.

5. Anzeige (10) nach Anspruch 4, dadurch gekennzeichnet, daß die besagte Flüssigkeit mindestens teilweise durchsichtig ist.

6. Anzeige (10) nach Anspruch 5, dadurch gekennzeichnet, daß das besagte Maschengitter (28) eloxiert ist.

7. Anzeige (10) nach Anspruch 6, dadurch gekennzeichnet, daß die besagten Pigmentteilchen gelb sind.

8. Anzeige (10) nach Anspruch 7, dadurch gekennzeichnet, daß die besagte Anzeige (10) eine erste Betriebsart, bei der die besagten Pigmentteilchen die Vordergrundkomponente eines angezeigten monochromatischen Bildes darstellen und das besagte Maschengitter (28) die Hintergrundkomponente des besagten angezeigten Bildes darstellt, und eine zweite Betriebsart, bei der die besagten Pigmentteilchen die Hintergrundkomponente des besagten angezeigten monochromatischen Bildes darstellen und das besagte Maschengitter (28) die Vordergrundkomponente des besagten angezeigten Bildes darstellt, aufweist.

9. Anzeige (10) nach Anspruch 8, dadurch gekennzeichnet, daß die besagte Anzeige (10) eine Triodenanzeige ist, bei der die Anode (26) in der Nähe des besagten durchsichtigen Teils und die Kathode (18) und das Gitter (20) im besagten Hinterteil angeordnet sind.

10. Anzeige (10) nach Anspruch 9, dadurch gekennzeichnet, daß der besagte durchsichtige Teil des besagten Gehäuses (12, 14) einen Teil enthält, durch den der besagte Hinterteil betrachtet werden kann.

11. Anzeige (10) nach Anspruch 8, dadurch gekennzeichnet, daß die besagte Anzeige (10) eine Tetrodenanzeige ist, bei der eine örtliche Anode (32) über dem Gitter (20) liegt, wobei die besagten Positionierungsmittel weiterhin die besagte örtliche Anode (32) enthalten.

12. Anzeige nach Anspruch 11, dadurch gekennzeichnet, daß der besagte durchsichtige Teil des besagten Gehäuses (12, 14) einen Teil enthält, durch den der besagte Hinterteil betrachtet werden kann.

13. Anzeige nach Anspruch 1, dadurch gekennzeichnet, daß die besagte Kathode (18) eine Mehrzahl von länglichen, im wesentlichen parallelen horizontalen Leitergliedern umfaßt, die in einer ersten Ebene angeordnet und mindestens teilweise in dem besagten Gehäuse enthalten sind, das besagte Gitter (20) eine Mehrzahl länglicher, im wesentlichen paralleler vertikaler Leiterglieder umfaßt, die mindestens teilweise im besagten Gehäuse (12, 14) enthalten und elektrisch von den besagten horizontalen Gliedern isoliert und in einer zweiten Ebene angeordnet sind, wobei die besagte erste und besagte zweite Ebene im wesentlichen parallel und in der Nähe voneinander liegen, wobei die besagte Mehrzahl horizontaler Glieder und die besagte Mehrzahl vertikaler Glieder eine Matrix mit einer Mehrzahl von Schnittpunkten bilden, wenn sie entlang einer Linie senkrecht zur besagten ersten und besagten zweiten Ebene betrachtet werden, und ein im wesentlichen planares Leiterglied (26) in einer dritten Ebene in der Nähe der und im wesentlichen parallel zur besagten zweiten Ebene und mindestens teilweise im besagten Gehäuse (12, 14) enthalten angeordnet ist, wobei das besagte Maschengittei (28) zwischen den besagten vertikalen Gliedern (20) und dem besagten planaren Glied (26) angeordnet ist.

14. Anzeige (10) nach Anspruch 13, dadurch gekennzeichnet, daß sich das besagte Maschengitter (28) im wesentlichen zusammen mit den besagten horizontalen Gliedern (18) und mit den besagten vertikalen Gliedern (20) erstreckt und eine Farbe aufweist, die zu der der besagten Pigmentteilchen im Kontrast steht.

15. Anzeige (10) nach Anspruch 14, dadurch gekennzeichnet, daß das besagte Maschengitter (28) von

den besagten vertikalen Gliedern (20) und dem planaren Leiterglied (26) elektrisch isoliert ist.

16. Anzeige (10) nach Anspruch 13, dadurch gekennzeichnet, daß die besagte Flüssigkeit im wesentlichen durchsichtig ist.

17. Anzeige (10) nach Anspruch 16, dadurch gekennzeichnet, daß das besagte Gehäuse (12, 14) eine erste flache Schirmplatte (12) umfaßt, von der ein Mittelteil der besagte durchsichtige Teil des besagten Gehäuses (12, 14) ist, wobei die besagte erste Schirmplatte (12) ein Substrat zum Tragen des besagten planaren Gliedes (26) ist.

18. Anzeige (10) nach Anspruch 17, dadurch gekennzeichnet, daß das besagte Gehäuse eine zweite im wesentlichen flache Schirmplatte (14) und mindestens einen Abstandhalter (16a, 16b) umfaßt, der dazwischengelegt und abdichtbar an der besagten ersten und zweiten Schirmplatte (12, 14) befestigt ist, um das besagte Gehäuse zu bilden, wobei die besagte Mehrzahl horizontaler Leiterglieder (18) in der Nähe der besagten zweiten Schirmplatte (14) positioniert ist.

19. Anzeige (10) nach Anspruch 18, dadurch gekennzeichnet, daß der besagte mindestens eine Abstandhalter zwei Abstandhalter (16a, 16b) umfaßt, von denen ein erster abdichtbar an der besagten ersten Schirmplatte (12) befestigt ist und ein zweiter abdichtbar an der besagten zweiten Schirmplatte (14) befestigt ist, wobei der besagte erste und zweite Abstandhalter (16a, 16b) abdichtbar in einer Entfernung von der besagten ersten und zweiten Schirmplatte (12, 14) aneinander haften und das besagte Maschengitter (28) dazwischen schichtweise anordnen.

20. Anzeige (10) nach Anspruch 19, dadurch gekennzeichnet, daß die besagte zweite Schirmplatte (14) ein Substrat zum Tragen der besagten Mehrzahl horizontaler Leiterglieder (18) ist.

21. Anzeige (10) nach Anspruch 20, dadurch gekennzeichnet, daß die besagte zweite Schirmplatte (14) mindestens teilweise durchsichtig ist und die besagte elektrophoretische Flüssigkeit dadurch sichtbar ist, wobei die besagte Anzeige (10) in ihrer Gesamtheit mindestens teilweise in einer zu besagter erster und zweiter Schirmplatte (12, 14) senkrechten Richtung lichtdurchlässig ist.

22. Anzeige (10) nach Anspruch 21, dadurch gekennzeichnet, daß das besagte Maschengitter (28) die Lichtdurchlässigkeit der besagten Anzeige (10) verringert.

23. Anzeige (10) nach Anspruch 22, dadurch gekennzeichnet, daß die besagten Pigmentteilchen gelb sind.

24. Anzeige (10) nach Anspruch 16, dadurch gekennzeichnet, daß der besagten Flüssigkeit ein Farbstoff von annähernd derselben Farbe wie das besagte Maschengitter (28) hinzugefügt wird.

25. Anzeige (10) nach Anspruch 21, dadurch gekennzeichnet, daß die besagte Anzeige (10) eine Triodenanzeige ist, wobei die besagte Mehrzahl horizontaler Glieder (18) die Kathode ist, die besagte Mehrzahl vertikaler Glieder (20) das Gitter ist und das besagte planare Glied (26) die Anode ist.

26. Anzeige (10) nach Anspruch 21, dadurch gekennzeichnet, daß die besagte Anzeige (10) eine Tetrodenanzeige ist, wobei die besagte Mehrzahl horizontaler Glieder (18) die Kathode ist, besagte Mehrzahl vertikaler Glieder (20) das Gitter ist und das besagte planare Glied (26) eine abgesetzte Anode ist, und weiterhin mit einer Mehrzahl örtlicher Anodenelemente (32), die auf den besagten Gitterelementen (20) zu diesen ausgerichtet und von diesen durch Zwischenisolatorstreifen (22) isoliert abgelagert sind.

27. Anzeige (10) nach Anspruch 1, dadurch gekennzeichnet, daß das besagte Positionierungsmittel die besagte Kathode (18), die aus einer Mehrzahl paralleler, in einer gegebenen Richtung angeordneter Leiterglieder besteht, ein von der besagten Kathode (18) isoliertes Gitter (20), das aus einer Mehrzahl von parallelen Leitergliedern besteht, die jeweils senkrecht zu den besagten Kathodenleitergliedern angeordnet sind, um eine X-Y-Adressiermatrix zu bilden, und eine von der besagten X-Y-Adressiermatrix getrennte herkömmliche Anode (26) umfaßt.

28. Vorrichtung (10) nach Anspruch 27, dadurch gekennzeichnet, daß das besagte Maschengitter (28) durch eine Mehrzahl von Lochungen (29) durchlöchert ist, durch die die besagten Teilchen durchlaufen, wobei das besagte Maschengitter (28), wenn es zwischen einen Betrachter und die besagten Pigmentteilchen gebracht wird. mindestens teilweise die besagten Pigmentteilchen von der Sicht verdeckt.

29. Vorrichtung (10) nach Anspruch 27, dadurch gekennzeichnet, daß die besagte Anzeige (10) weiterhin eine örtliche Anode (32) enthält, die eine Mehrzahl von parallelen Leitergliedern umfaßt, die jeweils mit einem entsprechenden Gitter(20)-Leiterglied verbunden sind und von diesem isoliert sind, wobei die besagte örtliche Anode (32) die Steue-

rung der Bahn der besagten Pigmentteilchen zu und von der besagten X-Y-Adressiermatrix und durch das besagte Maschengitter (28) bewirkt und überschüssiges Pigment an der besagten herkömmlichen Anode (26) beläßt.

30. Verfahren zum Betreiben einer elektrophoretischen Anzeige (10) gemäß Anspruch 27 mit folgenden Schritten:

elektrisches Anschalten der besagten Kathode (18), des besagten Gitters (20), des besagten Maschengitters (28) und der besagten herkömmlichen Anode (26) an eine Quelle elektrischer Potentialenergie, wobei die besagte Quelle einen Bereich unabhängiger und gezielt veränderlicher Spannungen für jeweils die besagte Kathode (18), das besagte Gitter (20), das besagte Maschengitter (28) und die besagte herkömmliche Anode (26) unter Steuerung von Steuerungsmitteln zum Steuern des von der besagten Quelle für jeweils die besagte Kathode (18), das besagte Gitter (20), das besagte Maschengitter (28) und die besagte herkömmliche Anode (26) zugeführten Spannungspegels bereitstellt, und
Steuern der besagten Quelle elektrischer Potentialenergie mit besagten Steuerungsmitteln, so daß zur Durchführung von Anzeigeoperationen Spannungspegel an die besagte Kathode (18), das besagte Gitter (20), das besagte Maschengitter (28) und die besagte herkömmliche Anode (26) angelegt werden.

31. Verfahren nach Anspruch 30, wobei der Betrieb der besagten Anzeige (10) das Versetzen der besagten Anzeige (10) in eine Betriebsart STROM AUS BILD HALTEN umfaßt, wobei ein geschriebenes besagtes Bild nach Entstromung der besagten Anzeige (10) auf der besagten Anzeige (10) gehalten wird, indem die besagte Quelle elektrischen Potentials von der besagten herkömmlichen Anode (26), der besagten Kathode (18), dem besagten Gitter (20) und dem besagten Maschengitter (28) in dieser Reihenfolge abgeschaltet wird.

32. Verfahren nach Anspruch 31, weiterhin mit dem Schritt des elektrischen Anschaltens der besagten gesteuerten Quelle elektrischer Potentialenergie an eine örtliche Anode (32), wobei im besagten Schritt des Steuerns Spannungspegel zur Durchführung von Anzeigeoperationen der besagten örtlichen Anode (32) zugeführt werden.

33. Verfahren nach Anspruch 32, wobei die besagte Anzeigeoperation das Versetzen der besagten Anzeige (10) in eine Betriebsart STROM AUS BILD HALTEN umfaßt, wobei ein geschriebenes besagtes Bild nach Entstromung der besagten Anzeige (10) auf der besagten Anzeige (10) gehalten wird, indem die besagte Quelle elektrischen Potentials von der besagten herkömmlichen Anode (26), der besagten örtlichen Anode (32), der besagten Kathode (18), dem besagten Gitter (20) und dem besagten Maschengitter (28) in dieser Reihenfolge abgeschaltet wird.

34. Verfahren nach Anspruch 33, wobei die besagte Anzeigeoperation das Versetzen der besagten Anzeige (10) in eine Betriebsart STROM AUS BILD HALTEN umfaßt, wobei ein geschriebenes besagtes Bild nach Entstromung der besagten Anzeige (10) auf der besagten Anzeige (10) gehalten wird, wobei die besagte Betriebsart STROM AUS BILD HALTEN dadurch erreicht wird, daß die besagte Quelle unter der Steuerung der besagten Steuerungsmittel Pegel von annähernd +200 V für die besagte herkömmliche Anode (26), -300 V für das besagte Maschengitter (28), +200 V für die besagte örtliche Anode (32), -10 V für das besagte Gitter (20) und +1,5 bis 3,0 V für die besagte Kathode (28) bereitstellt, und daß dann die besagte Quelle elektrischen Potentials von der besagten herkömmlichen Anode (26), der besagten örtlichen Anode (32), dem besagten Gitter (20), der besagten Kathode (20) und dem besagten Maschengitter (28) in dieser Reihenfolge abgeschaltet wird.

Revendications

1. Affichage électrophorétique (10) comportant:

(a) une enveloppe étanche au fluide (12,14) comportant une partie qui est au moins partiellement transparente;
(b) un fluide électrophorétique contenu dans ladite enveloppe (12,14) dans lequel sont suspendues des particules de colorant;
(c) un moyen pour positionner sélectivement (18,20,26) lesdites particules à l'intérieur de ladite enveloppe (12,14) de telle sorte que lesdites particules forment des images qui sont visibles par un observateur regardant à travers ladite partie transparente, le moyen de positionnement sélectif comportant une cathode (18), une grille (20) et une anode (26); et,
(d) un tamis (28) composé d'une matière électriquement conductrice disposé à l'intérieur de ladite enveloppe (12,14) et divisant un espace intérieur dans ladite enveloppe (12,14) contenant ledit fluide en une partie avant proche de ladite partie transparente de ladite enveloppe (12,14) et une partie arrière distante de ladite partie transparente, ledit tamis (28) étant sélectivement chargeable électriquement pour indui-

re un déplacement des particules à l'intérieur dudit fluide en coopération avec ledit moyen de positionnement (18,20,26),

caractérisé en ce que ledit tamis (28) est au moins partiellement opaque quand il est visualisé à travers ladite partie transparente de ladite enveloppe (12,14) et cache lesdites particules qui ne sont plus visibles à travers ladite partie transparente quand lesdites particules se trouvent dans ladite partie arrière, ledit tamis (28) permettant auxdites particules de passer à travers sous la commande dudit moyen de positionnement (18,20,26) de telle que lesdites particules peuvent être vues ou cachées en fonction de la position desdites particules par rapport audit tamis (28).

2. Affichage (10) conformément à la revendication 1, caractérisé en ce que lesdites particules de colorant ont une couleur qui est différenciable de celle dudit fluide et de celle dudit tamis (28).

3. Affichage (10) conformément à la revendication 2, caractérisé en ce que le rapport de surface ouverte dudit tamis (28) est approximativement de 40% à 50%.

4. Affichage (10) conformément à la revendication 3, caractérisé en ce que ledit tamis (28) est de couleur noire.

5. Affichage (10) conformément à la revendication 4, caractérisé en ce que ledit fluide est au moins partiellement transparent.

6. Affichage (10) conformément à la revendication 5, caractérisé en ce que ledit tamis (28) est anodisé.

7. Affichage (10) conformément à la revendication 6, caractérisé en ce que lesdites particules de colorant sont jaunes.

8. Affichage (10) conformément à la revendication 7, caractérisé en ce que ledit affichage (10) a un premier mode de fonctionnement dans lequel lesdites particules de colorant représentent la composante de premier plan d'une image monochrome affichée et ledit tamis (28) représente la composante d'arrière-plan de ladite image affichée et un deuxième mode de fonctionnement dans lequel lesdites particules de colorant représentent la composante d'arrière-plan de ladite image monochrome affichée et ledit tamis (28) représente la composante de premier plan de ladite image affichée.

9. Affichage (10) conformément à la revendication 8, caractérisé en ce que ledit affichage (10) est un affichage du type triode dont l'anode (26) est disposée à proximité de ladite partie transparente, la cathode (18) et la grille (20) étant disposées dans ladite partie arrière.

10. Affichage (10) conformément à la revendication 9, caractérisé en ce que ladite partie transparente de ladite enveloppe (12,14) comporte une partie à travers laquelle peut être visualisée ladite partie arrière.

11. Affichage (10) conformément à la revendication 8, caractérisé en ce que ledit affichage (10) est un affichage de type tétrode ayant une anode locale (32) recouvrant la grille (20) ledit moyen de positionnement comportant en outre ladite anode locale (32).

12. Affichage conformément à la revendication 11, caractérisé en ce que ladite partie transparente de ladite enveloppe (12,14) comporte une partie à travers laquelle ladite partie arrière peut être visualisée.

13. Affichage conformément à la revendication 1, caractérisé en ce que ladite cathode (18) comporte une pluralité d'éléments conducteurs horizontaux allongés substantiellement parallèles disposés dans un premier plan et au moins partiellement contenus dans ladite enveloppe, ladite grille (20) comporte une pluralité d'éléments conducteurs verticaux allongés substantiellement parallèles et au moins partiellement contenus dans ladite enveloppe (12,14) isolés électriquement desdits éléments horizontaux et disposés dans un deuxième plan, lesdits premier et deuxième plans étant substantiellement parallèles et à proximité l'un de l'autre, ladite pluralité d'éléments horizontaux et ladite pluralité d'éléments verticaux formant une matrice avec une pluralité d'intersections visualisée le long d'une ligne perpendiculaire auxdits premier et deuxième plans, et un élément conducteur substantiellement plan (26) disposé à l'intérieur d'un troisième plan proche et substantiellement parallèle audit deuxième plan et au moins partiellement contenu à l'intérieur de ladite enveloppe (12,14), ledit tamis (28) étant disposé entre lesdits éléments verticaux (20) et ledit élément plan (26).

14. Affichage (10) conformément à la revendication 13, caractérisé en ce que ledit tamis (28) s'étend substantiellement conjointement avec lesdits éléments horizontaux (18) et avec lesdits éléments verticaux (20) et a une couleur contrastant avec celle desdites particules de colorant.

15. Affichage (10) conformément à la revendication 14, caractérisé en ce que ledit tamis (28) est électriquement isolé desdits éléments verticaux (20) et de l'élément conducteur plan (26).

16. Affichage (10) conformément à la revendication 13, caractérisé en ce que ledit fluide est substantiellement transparent.

17. Affichage (10) conformément à la revendication 16, caractérisé en ce que ladite enveloppe (12,14) comporte une première plaque plate (12), dont une partie centrale est ladite partie transparente de ladite enveloppe (12,14), ladite première plaque (12) étant un substrat pour supporter ledit élément plan (26).

18. Affichage (10) conformément à la revendication 17, caractérisé en ce que ladite enveloppe comporte une deuxième plaque substantiellement plate (14) et au moins un écarteur (16a,16b) interposé entre lesdites première et deuxième plaques (12,14) et fixé de manière étanche à celles-ci pour former ladite enveloppe, ladite pluralité d'éléments conducteurs horizontaux (18) étant positionnés à proximité de ladite deuxième plaque (14).

19. Affichage (10) conformément à la revendication 18, caractérisé en ce que ledit au moins un écarteur comporte deux écarteurs (16a,16b), un premier fixé de manière étanche à ladite première plaque (12) et un deuxième fixé de manière étanche à ladite deuxième plaque (14), lesdits premier et deuxième écarteurs (16a,16b) étant fixés de manière étanche l'un à l'autre à distance desdites première et deuxième plaques (12,14) et prenant en sandwich entre eux ledit tamis (28).

20. Affichage (10) conformément à la revendication 19, caractérisé en ce que ladite deuxième plaque (14) est un substrat pour supporter ladite pluralité d'éléments conducteurs horizontaux (18).

21. Affichage (10) conformément à la revendication 20, caractérisé en ce que ladite deuxième plaque (14) est au moins partiellement transparente et ledit fluide électrophorétique est visible à travers, ledit affichage (10) étant dans sa totalité au moins partiellement translucide dans une direction perpendiculaire auxdites première et deuxième plaques (12,14).

22. Affichage (10) conformément à la revendication 21, caractérisé en ce que ledit tamis (28) réduit la translucidité dudit affichage (10).

23. Affichage (10) conformément à la revendication 22, caractérisé en ce que lesdites particules de colorant sont jaunes.

24. Affichage (10) conformément à la revendication 16, caractérisé en ce qu'une teinture d'approximativement la même couleur que ledit tamis (28) est ajoutée audit fluide.

25. Affichage (10) conformément à la revendication 21, caractérisé en ce que ledit affichage (10) est un affichage du type triode, ladite pluralité d'éléments horizontaux (18) étant la cathode, ladite pluralité d'éléments verticaux (20) étant la grille et ledit élément plan (26) étant l'anode.

26. Affichage (10) conformément à la revendication 21, caractérisé en ce que ledit affichage (10) est un affichage du type tétrode, ladite pluralité d'éléments horizontaux (18) étant la cathode, ladite pluralité d'éléments verticaux (20) étant la grille et ledit élément plan (26) étant une anode distante et comportant en outre une pluralité d'éléments d'anode locale (32) déposés sur lesdits éléments de grille (20) en alignement avec ceux-ci et isolés de ceux-ci par des bandes isolantes intersticielles (22).

27. Affichage (10) conformément à la revendication 1, caractérisé en ce que ledit moyen de positionnement comporte ladite cathode (18) consistant en une pluralité d'éléments conducteurs parallèles disposés dans un sens donné, une grille (20) isolée de ladite cathode (18) et consistant en une pluralité d'éléments conducteurs parallèles chacun perpendiculaire auxdits éléments conducteurs de cathode pour former une matrice d'adressage X-Y, et une anode conventionnelle (26) séparée de ladite matrice d'adressage X-Y.

28. Affichage (10) conformément à la revendication 27, caractérisé en ce que ledit tamis (28) est perforé par une pluralité de perforations (29) au travers desquelles passent lesdites particules, ledit tamis (28) quand il est interposé entre un observateur et lesdites particules de colorant cachant au moins partiellement au regard lesdites particules de colorant.

29. Affichage (10) conformément à la revendication 27, caractérisé en ce que ledit affichage (10) comporte en outre une anode locale (32) comprenant une pluralité d'éléments conducteurs parallèles chacun associé à et isolé d'un élément conducteur de grille (20) respectif, ladite anode locale (32) fonctionnant pour commander le trajet desdites particules de colorant vers et depuis ladite matrice d'adressage X-Y et à travers ledit tamis (28) et pour permettre à l'excès de colorant de rester au niveau de ladite anode conventionnelle (26).

30. Procédé de fonctionnement d'un affichage électrophorétique (10) tel que défini à la revendication 27 qui comporte les étapes de:

connexion électrique de ladite cathode (18), de ladite grille (20), dudit tamis (28) et de ladite

anode conventionnelle (26) à une source d'énergie de potentiel électrique, ladite source fournissant une gamme de tensions indépendantes et sélectivement variables à chacune de ladite cathode (18), de ladite grille (20), dudit tamis (28) et de ladite anode conventionnelle (26) sous la commande d'un moyen de commande pour commander le niveau de tension fourni par ladite source à chacun de ladite cathode (18), de ladite grille (20), dudit tamis (28) et de ladite anode conventionnelle (26), et commande de ladite source d'énergie de potentiel électrique avec ledit moyen de commande de telle sorte que les niveaux de tension soient appliqués à ladite cathode (18), à ladite grille (20), audit tamis (28) et à ladite anode conventionnelle (26) pour effectuer les opérations d'affichage.

31. Procédé de la revendication 30, dans lequel le fonctionnement dudit affichage (10) comporte le placement dudit affichage (10) dans un mode de MAINTIEN D'IMAGE AVEC L'ALIMENTATION COUPEE dans lequel ladite image est maintenue sur ledit affichage (10) après la coupure de l'alimentation dudit affichage (10) en déconnectant ladite source de potentiel électrique de ladite anode conventionnelle (26), de ladite cathode (18), de ladite grille (20) et dudit tamis (28), dans cet ordre.

32. Procédé de la revendication 31, comprenant en outre l'étape de connexion électrique de ladite source commandée d'énergie de potentiel électrique à une anode locale (32), les niveaux de tension fournis à ladite anode locale (32) étant inclus dans ladite étape de commande en vue de l'exécution des opérations d'affichage.

33. Procédé de la revendication 32, dans lequel le fonctionnement dudit affichage comporte le placement dudit affichage (10) dans un mode de MAINTIEN D'IMAGE AVEC L'ALIMENTATION COUPEE dans lequel une image écrite est maintenue sur ledit affichage (10) après la coupure de l'alimentation dudit affichage (10) en déconnectant ladite source de potentiel électrique de ladite anode conventionnelle (26), de ladite anode locale (32), de ladite cathode (18), de ladite grille (20) et dudit tamis (28), dans cet ordre. 33

34. Procédé de la revendication 33, dans lequel le fonctionnement dudit affichage comporte le placement dudit affichage (10) dans un mode de MAINTIEN D'IMAGE AVEC L'ALIMENTATION COUPEE dans lequel une image écrite est maintenue sur ledit affichage (10) après la coupure de l'alimentation dudit affichage (10), ledit mode de MAINTIEN D'IMAGE AVEC L'ALIMENTATION COUPEE étant réalisé par ladite source fournissant sous la commande dudit moyen de commande des niveaux approximatifs de +200 v à ladite anode conventionnelle (26), -300 v audit tamis (28), +200 v à ladite anode locale (32), -10 v à ladite grille (20) et +1,5 à 3,0 v à ladite cathode (28), puis par la déconnexion de ladite source de potentiel électrique de ladite anode conventionnelle (26), de ladite anode locale (32), de ladite grille (20), de ladite cathode (20) et dudit tamis (28), dans cet ordre.

FIG. 1

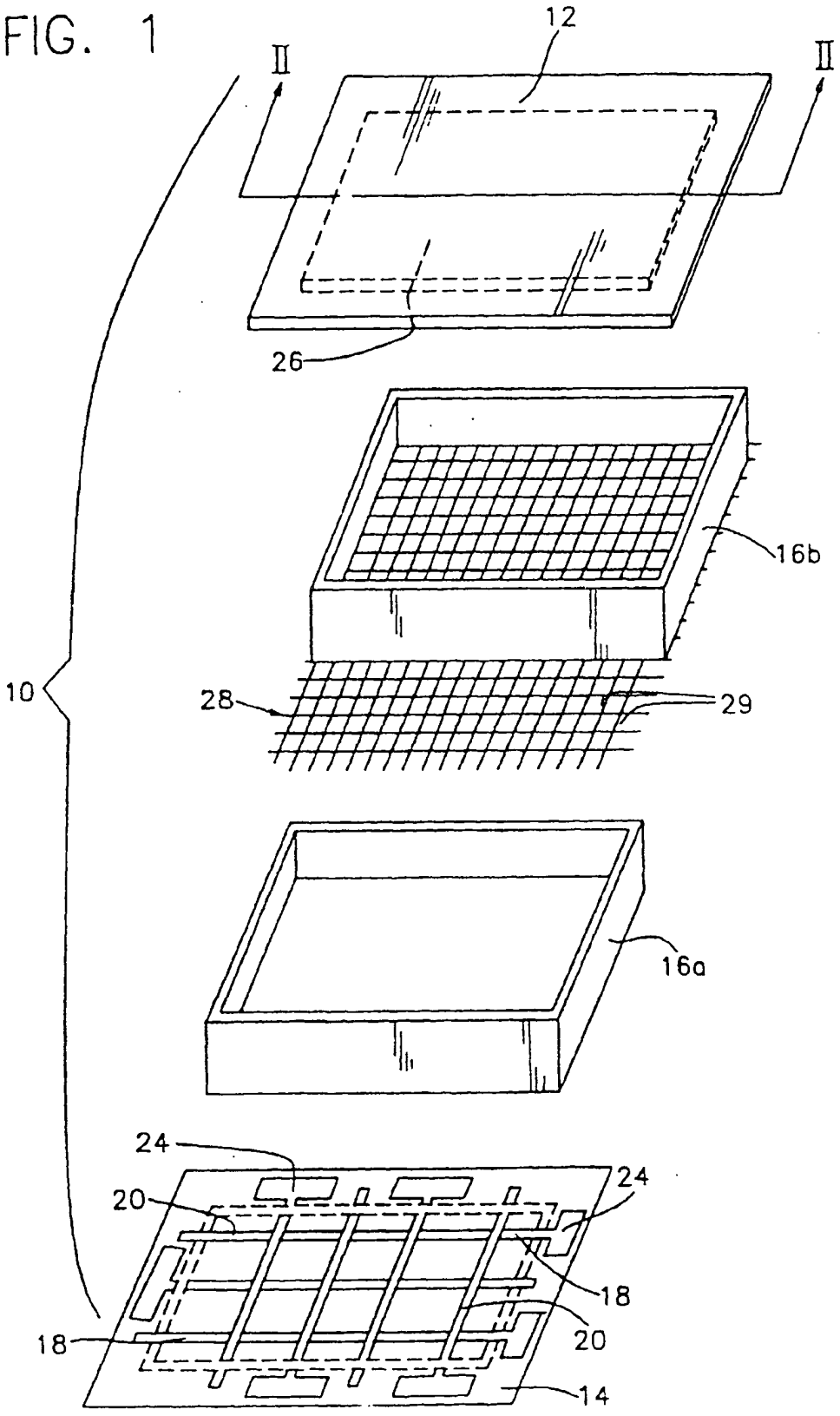


FIG. 2

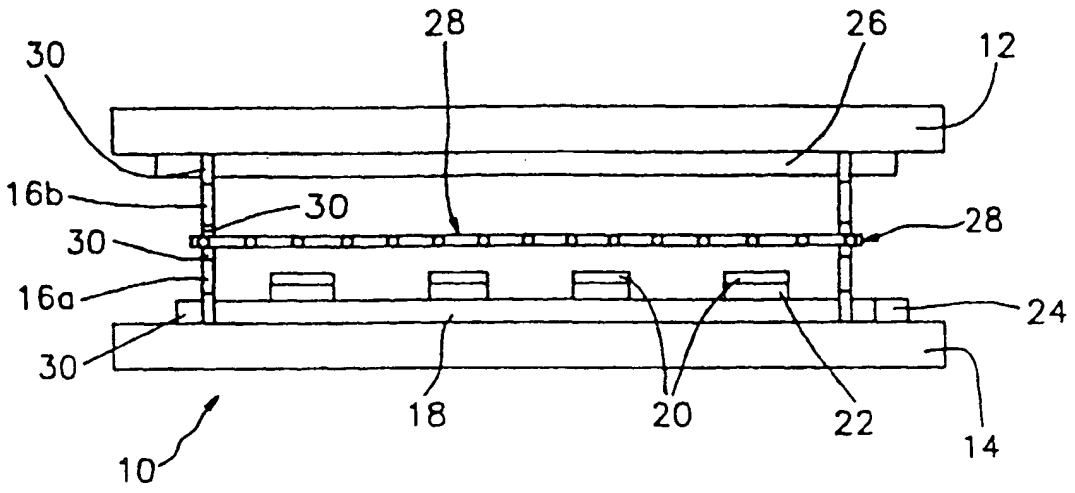

28
26
12
30
16b
30
30
28
16a
24
30
18
20
22
14
10

FIG. 4

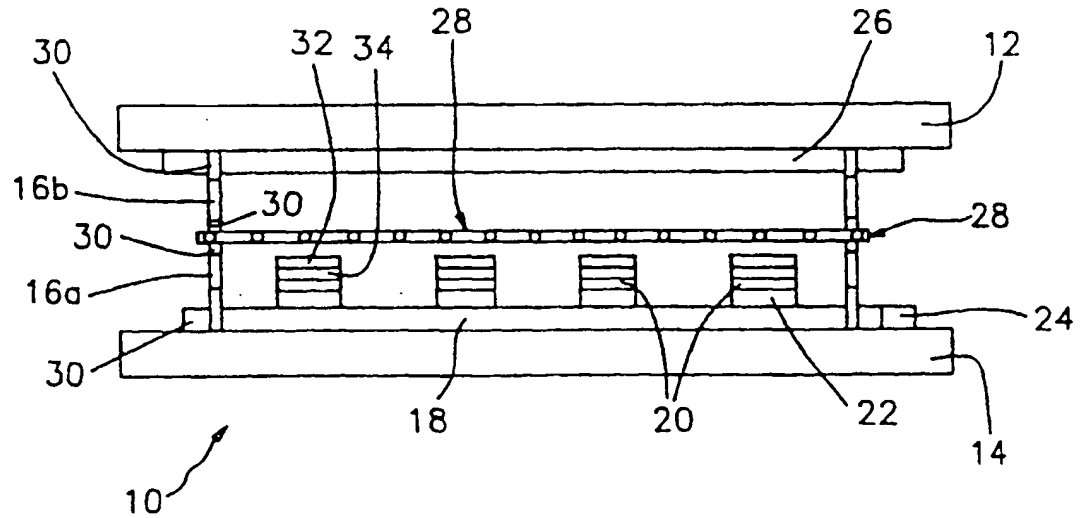

28
26
12
30
32
34
16b
30
30
28
16a
24
30
18
20
22
14
10

FIG. 3

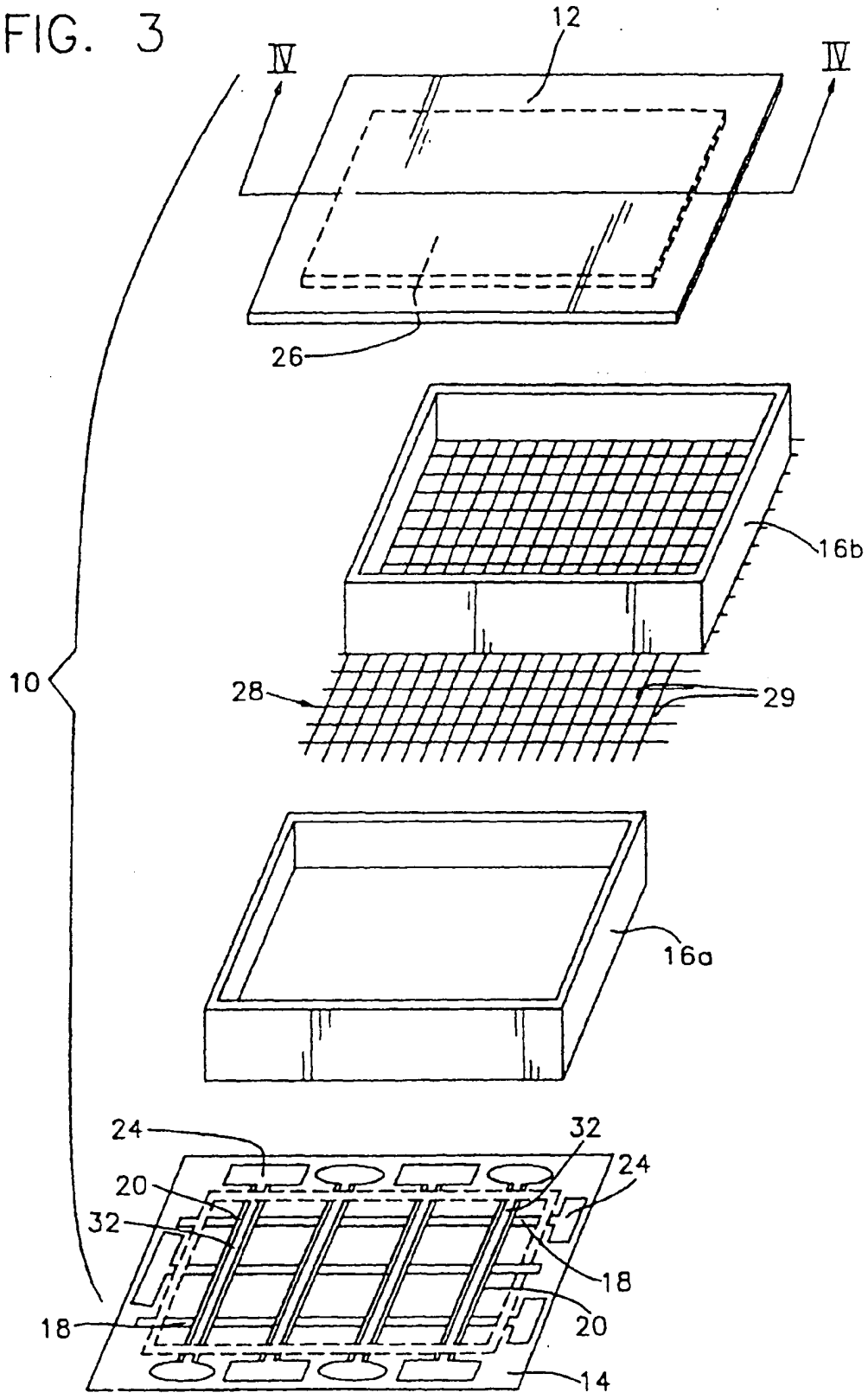
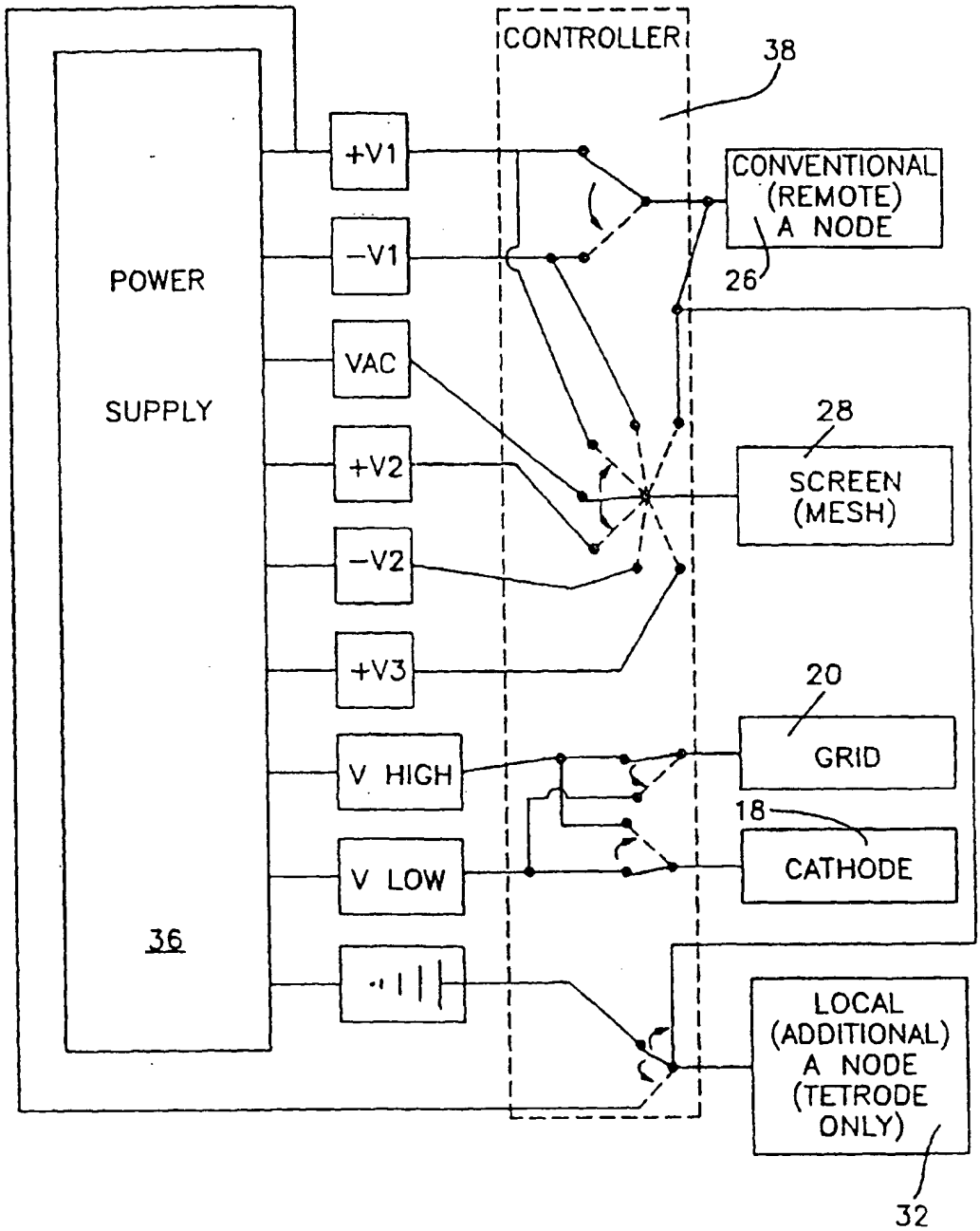


FIG. 5


CONTROLLER
38
POWER
SUPPLY
36
+V1
−V1
VAC
+V2
−V2
+V3
V HIGH
V LOW
CONVENTIONAL (REMOTE) A NODE
26
28
SCREEN (MESH)
20
GRID
18
CATHODE
LOCAL (ADDITIONAL) A NODE (TETRODE ONLY)
32